



**SPACE**   
awareness

**CLIMATE CHANGE:  
THE GREENHOUSE EFFECT**

**DIDACTIC COURSE**

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## Information about the course

**Brief description:** In this activity, students will be able to learn about the main cause of climate change, the Greenhouse effect and how it impacts our Earth. To do so, they will test a series of hypotheses using an experimental activity.

**Curriculum topic:**  
Climate Change – The Greenhouse Effect

**Category:**  
Our fragile planet

**Keywords:**  
greenhouse effect, greenhouse gases; atmosphere

**Age range:**  
10-13

**Education level:**  
Primary

**Language:**  
English

**Students' prior knowledge:**  
The planet Earth

**Didactical hours:**  
2-3

### **Educational Objectives:**

Know what the greenhouse effect is

Know what the atmosphere is

Discover that the atmosphere is very thin compared with the Earth diameter

Discover how the greenhouse effect works through an experimental activity

Know some positive as well as negative consequences of the greenhouse effect

Know that without the greenhouse effect and the atmosphere there would not be any life on Earth

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## STEPS

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## ORIENTATION

Present the students with what they will study about in this lesson. Ask them what they know on the topic.

“Today we will learn about the greenhouse effect.”

“We’ll look at how it occurs, how it impacts our Earth. We will discover some positive as well as negative consequences of the greenhouse effect.”

“Before we start, very quickly, what do you know about the greenhouse effect?”

After a short discussion, provide these questions to your students:

- Which are the greenhouse gases?
  - Answer: carbon dioxide, methane nitrous oxide;
- What is the role of these gases related to Earth?
  - Answer: Greenhouse gases trap the heat from the Sun.;
- Is it good or bad to the Earth?
  - e.g. Without the greenhouse effect people would not be able to live on Earth;

Open the lesson with a video about climate change.

“That’s great, so we already have some idea about what the greenhouse effect is. Let’s see exactly how it works.”

“Please pay attention to the video as you’ll have this set of questions to answer at the end. Remember to write down your answers.”

Video: [https://www.youtube.com/watch?v=x\\_sJzVe9P\\_8](https://www.youtube.com/watch?v=x_sJzVe9P_8) (Length 7.14)

Students can write down their answers in an Evernote note and at the end of the videos, ask them to share them and have a brief class discussion to summarise what they’ve learned from the videos.

After the video, open a Padlet wall and write down their answers so that they can have the overview of the discussion somewhere they can see it.

“In conclusion, the Earth has an atmosphere and the greenhouse gases hang like a blanket in the atmosphere, which is why the Earth is getting steadily warmer.

The greenhouse effect has positive as well as negative consequences.

Without the greenhouse effect people would not be able to live on Earth!

The average temperature would be -15° Celsius.”

### **EXTRA GUIDELINES**

#### **Use of ICT tools and other resources**

Before starting the lesson, make sure all students know how to use Padlet and Evernote.

You will use:

- YouTube

Students will use:

- Evernote (optional), to take notes
- Padlet, to share answers with the rest of the class.

Try searching online for videos and images. You may also wish to create your own images in order to make a more personalized presentation.

#### **Tips for a diverse classroom**

- Invite all students to contribute to class discussion even if some student answered wrong. Ask them what was that got them confused.
- Create an invitation to speak. The sense that there is an invitation to speak without being put on the spot can be a strong inducement to participate.
- Give students time to answer and be sure to indicate that you are paying as much attention to the hesitant ones as to others.

#### **Main Skills involved**

- Active Listening – Giving full attention to the teacher while presenting the riddle and the aphorism and other students' ideas about how to solve the tasks.
- Speaking – Speaking their minds on each riddle/aphorism pointing out key points of the riddle that may lead to the solution.

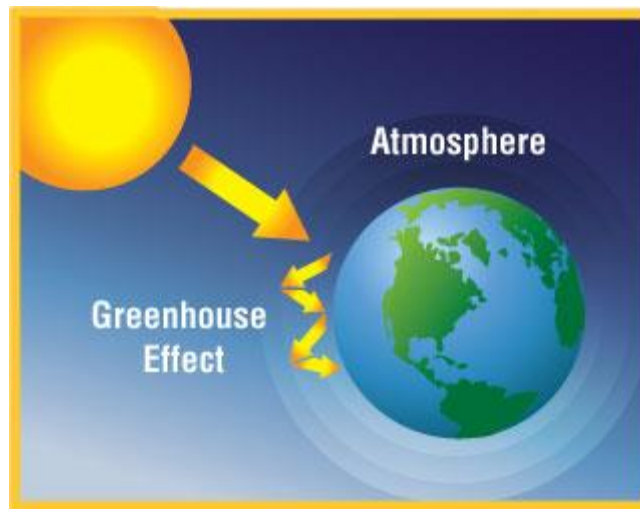
## **CONCEPTUALISATION**

### **Hypothesis**

Now that they have a general overview of the topic they will study today, explain to your students that in this second phase of the lesson, they will have to refine the concepts associated with the greenhouse effect and also identify relationships between them, based on which they will formulate hypotheses to test later on in the lesson.

Before starting this, split them in groups of five.

Each group will receive a sheet of paper including the picture below:



“If it were not for greenhouse gases trapping heat in the atmosphere, the Earth would be a very cold place. Greenhouse gases keep the Earth warm through a process called the greenhouse effect.”

“But what will happen if the quantity of trapped gases increases?”

Ask them to make hypothesis (ideally, it will take no more than 5 minutes) related to their real life.

Each group will add the hypothesis made on Padlet.

## **EXTRA GUIDELINES**

### **Suggested ICT tools and other resources**

At this part of the activity students use Padlet <http://padlet.com/> as an online blackboard to write down their hypothesis.

### **Tips for a diverse classroom**

- Make sure the groups are random, with as little gender or social groupings as possible.
- As they work in groups, make sure you visit everyone and encourage all students to speak so there are no gender monopolies or more confident students overtaking the activity.

### **Main Skills involved**

- Critical Thinking - Using logic and reasoning to identify the concepts involved, preliminary explanations and hypothesis, map approaches to problems.
- Use of Science – Refer to previous knowledge and scientific rules related to the subject.
- Systems Evaluation - Identifying variables of the problem and the relations between them so as to make an effective hypothesis.

## INVESTIGATION

### Exploration

In this stage, your students will test the hypothesis they came up with and investigate the consequences of the greenhouse effect on the temperature on Earth.

“Now that we’ve decided what to test, let’s investigate the consequences of the greenhouse effect on the temperature on Earth.”

Give each child a sheet of A4 paper and a colouring pencil.

“You are going to draw the Earth and its atmosphere. The atmosphere is a layer of air surrounding the Earth”

Hand out the compasses and rulers. The children use the ruler to adjust the compass so that they can draw a circle with a diameter of 13 centimetres. This circle represents the Earth. They draw a very thin line around this circle using a colouring pencil. This line represents the atmosphere. To be in scale, it must not be more than 1 millimetre thick. Ask the children what they especially notice about the size of the line.

“What do you especially notice about the size of the line?”

The children discover that this layer is very thin.

“In conclusion, compared with the Earth, the atmosphere is very thin”

“The atmosphere keeps the greenhouse gases from escaping into space. Not all planets have an atmosphere; Saturn for example consists of gas and does not have a separate atmosphere. You are going to carry out an experiment to see what effect an atmosphere has on a planet.”

### Experimentation

Give each group a number. Divide each group into pairs.

“With your partner, make one planet Earth with an atmosphere and one planet without an atmosphere. Make both planets identical.”

Each pair will make a planet. Give the children the materials they need and a marker pen to write their group number on the bottles and what each bottle represents. Print and provide each group with the worksheet: <http://bit.ly/2f1R8Jf>

Explain you students to follow these instructions for each planet, and provide help if they don't understand the process:

1. Put the funnel in the mouth of the bottle.
2. Pour soil through the funnel until you have a layer a few centimetres thick in the base of the bottle.
3. Make the soil wet by adding 2 or 3 spoonful of water.
4. Now attach the string to the thermometer using sticky tape. Hang the thermometer in the bottle as shown in the drawing.
5. Tape the other end of the thread to the outside of the bottle, ensuring that the thermometer is hanging just above the soil.
6. Screw the lid only onto the bottle that represents the planet with an atmosphere and do not cover the other planet. Write on each bottle which planet it represents and the number of your group.
7. After 15 minutes, read the temperatures shown on the thermometers.

Show the temperatures on the thermometers on the worksheet.

Ask them to complete steps 1 to 6 on Task 3 of the worksheet. They place their bottles on a sunny windowsill. After 15 minutes they complete Task 3 on the worksheet.

“In conclusion, the thermometer in the bottle 'Earth' shows a higher temperature. This is because the air in this bottle cannot escape, so it keeps getting warmer. The warm air in the bottle without an 'atmosphere' keeps coming into contact with cooler air, so it cools down again. This is why there is such a big difference between the minimum and maximum temperatures on a planet without an atmosphere. The heat is retained for longer on a planet with an atmosphere.”

#### **EXTRA GUIDELINES**

##### **Suggested ICT tools and other resources**

Instead of providing sheets, students can use programmes like MS Paint for PCs or SketchBook for tablets and mobile devices to draw the planets and the atmosphere.

The worksheet used in this didactic course (<http://bit.ly/2f1R8Jf>) is titled “The greenhouse effect”. It is a classroom resource for primary level developed by ESERO NL.

**Materials for the experiment:**

- 2 empty 1.5 litre bottles
- 2 thermometers
- Thread
- Soil
- Water
- Spoon
- Funnel
- Sticky tape
- Marker pen
- Printed worksheet (optional)

**Data interpretation**

After students have executed their experiment plan, they will have to interpret all of their findings.

“Now that we’ve concluded our research, we have a lot of raw data on our hands: data that needs to be processed just a bit more to be able to draw conclusions from it.”

Children answer the research question on the worksheet:

- What are the consequences of the greenhouse effect on the temperature on Earth?
  - o Answer: The greenhouse effect keeps the Earth steadily warmer.
- Complete the following sentence: If the Earth did not have an atmosphere, then...
  - o Answer: the temperature differences on Earth would be too great.
- What is the negative consequence of the greenhouse effect?
  - o Answer: It could make the Earth warmer than usual.



**EXTRA GUIDELINES**

**Suggested ICT tools and other resources**

- Printed worksheet
- Padlet

**Tips for a diverse classroom**

- Develop a positive climate in the class that promotes excellence. Encourage your students (as a group or individually) to consult with you if they have problems during their inquiry. This is also an indirect way to get to know your students and thus be able to tackle assumptions you might have about their learning behaviour and capacities based on their gender or cultural background.
- Have high expectations for all your students. Keep an eye on teams and make sure you spot cases where a student underperforms.
- Make sure the same students do not always put themselves in the position of leadership. Assigning roles (deliberately or randomly) may assist here in ensuring that all students get a chance to take on different responsibilities (manipulating equipment, recording results, reporting back etc.).
- Create a cooperative instead of a competitive environment within each group and among groups.

## CONCLUSION

Discuss the tasks and come to the conclusion. The conclusion will be added on the Padlet.

Based on the data interpretation students made in the previous phases, ask your students to compare the data obtained with their initial hypotheses.

“Let’s go back to our initial hypotheses now and see what changed. Did we make a good assumption? What new insights have we gained?”

Bring to the students’ attention any mistakes they made in the previous phase, and which they failed to figure out, so as to correct them.

“In conclusion, we would not be able to live on Earth if there was no atmosphere and no greenhouse effect. Without an atmosphere the temperature differences on Earth would be too great. With an atmosphere but no greenhouse effect it would be too cold to live on Earth”

### EXTRA GUIDELINES

#### Suggested ICT tools and other resources

Tools that could be useful in the conclusion phase are:

- Printed worksheet
- Padlet
- Notebooks

#### Tips for a diverse classroom and ensure gender balance

- Encourage students to include multiple perspectives and consider alternative explanations.
- Don’t allow students to be interrupted or intimidated.
- Give students time to draw their conclusions and be sure that you are paying attention to all of them equally.
- Refer to a silent student’s work in an affirming way.
- Give credit and attention to hesitant, shy or quiet students.
- Ask all students to take turns in making conclusions.

#### Main Skills involved

- Critical Thinking – Assess the result derived in order to draw correct conclusion. Consider alternative explanation.
- Active Listening – Paying attention to the opinion of classmates and take into account the proposals they provide.

- Reading and Comprehension – Refer to literature and relevant theory in order to draw conclusions.
- Speaking – Communicate conclusions to teammates based on thoughts and solid arguments.
- Monitoring – Assess other team mates’ arguments and their degree of contribution to the team. Encourage quiet team mates to participate more.
- Active Learning – Paying attention to classmates and combining opinions to draw correct conclusions.
- Writing – Be able to produce a written report of the experimentation process and how the team came to its conclusions based on scientific knowledge and rational arguments.
- Systems Analysis – Be able to comment on the overall quality of the experimentation and decide whether it was successful or not based on the conclusions drawn.
- Social Perceptiveness – Being aware of team mates’ reactions and understanding why they react as they do. Understand if all team mates agree to the team’s conclusions and if not why.
- Use of Science – Use scientific rules, prior and new knowledge in order to draw conclusions based on the data gathered and rational arguments.
- Systems Evaluation – Be able to draw conclusions on the overall experimental process

## DISCUSSION

### Communication

Now that students have a clear view of their conclusions and have corrected their initial assumptions, they can present their findings to the rest of the class.

Ask your students to incorporate their inquiry process into a group poster and ask them to be as creative as possible.

“Our research is now complete and at the end of the lesson it’s important that we share our work with the rest of class and reflect on what went well and what can be improved.

“When scientists and researchers do their work, they don’t keep it to themselves - they think: *Woah, the world needs to know about this! This could help a lot of people, even revolutionize the way we think about this!*”

“They also know that research isn’t always perfect and that you always need to improve and tinker with the way you research to be able to do it better next time.”

After each group picks their way of working, write down on the board the steps through which they have to go in their discussion and reflection.

“Please make sure you incorporate these steps into your presentation. In this way we can maximize all that we’ve learned and also help our colleagues to better understand what each group did”

Make sure to offer them guidance in presenting their findings and using a scientific approach as much as possible by addressing all of the steps of their inquiry process, regardless of their way chosen way of presenting.

### Reflection

In their presentation, make sure that they include a reflection section. You can give them the following questions to answer for this sub phase:

- Did you complete all activities correctly? Be honest about your work.
- What went well and what went wrong through all of the phases that you went through in this lesson? Reflect on your actions and approach to the scientific process (avoid placing the blame on something or someone else);

- List a series of things that you will change and do differently next time to have an even more successful inquiry process;

At the end, have each group present their poster.

“Taking turns, each group will come up and present their work today.”

They picture it and add the photo on the Padlet.

### **EXTRA GUIDELINES**

#### **Suggested ICT tools and other resources**

PowerPoint or Prezi can also be used instead of posters.

- Materials for posters
- Padlet Presentation tools (MS PowerPoint, Open Office Impress, Prezi)

#### **Tips for a diverse classroom and ensure gender balance**

- Be encouraging with students to use their creativity
- Support students in being honest with themselves and correct in the reflection process; don't allow bullying, teasing or blaming
- Allow the presentation of multiple opinions and perspectives.
- Use examples from multiple backgrounds and perspectives. The same groups should not be always used for demonstrating positive or negative examples.
- Be sensitive to cultural differences in writing styles, recognizing that many standards apply to the evaluation of good writing and presenting.
- Be explicit about what is expected and show examples of good writing done by other students.
- Be sensitive to the experiences of visibly underrepresented students in your class.

#### **Main Skills involved**

- Active Listening – Giving full attention to class mates and to what other teams are presenting. Taking time to understand what other teams did. Asking questions on their work and results.

- Reading and Comprehension – Be able to understand the written reports of other teams and assess them. Be able to read relevant theory and reflect on new knowledge.
- Speaking – Be able to communicate the work of the team as well as the results derived using scientific terms properly and scientifically valid arguments.
- Active Learning – Giving full attention to class mates, taking time to understand their point of view and compare different points of view.
- Time Management – Be able to prepare the team's play on time and make it fit to the time frame allowed for presentation.
- Social Perceptiveness - Being aware of team mates' reactions and understanding why they react as they do while making the final play. Being aware of others teams' reactions during the play and understanding why they react as they do.



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